UNITED STATES DISTRICT COURT
DISTRICT OF MINNESOTA

IN RE: NATIONAL HOCKEY LEAGUE PLAYERS' CONCUSSION INJURY LITIGATION	)	MDL No. 14-2551 (SRN/BRT)
This Document Relates to: ALL ACTIONS	)	

PLAINTIFFS' MEMORANDUM OF LAW IN OPPOSITION TO DEFENDANT NATIONAL HOCKEY LEAGUE'S MOTION TO EXCLUDE THE TESTIMONY OF THOMAS BLAINE HOSHIZAKI, PH.D.

(FILED UNDER SEAL)

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INTRODUCTION

The Court should deny Defendant National Hockey League's Motion to Exclude the Opinions and Testimony of Thomas Blaine Hoshizaki, Ph.D [ECF Doc. 781]. The National Hockey League's (hereinafter "NHL") scattershot attempts to exclude the testimony of Dr. Thomas Blaine Hoshizaki, a renowned expert in the field of brain trauma from head impacts, are legally unsupported at the *Daubert* stage, let alone at the class certification stage, as well as wholly lacking in substantive merit.

The vast majority of the NHL's contentions—concerning alleged shortcomings in calculations and inadequacies in study—are not only incorrect due to Dr. Hoshizaki's properly designed methodologies, but are also more properly the subject of cross-examination at trial rather than exclusion of evidence. Out of fear of Dr. Hoshizaki's conclusions and their consequence in terms of the damage that the NHL has caused to former players, the NHL also suggests that Dr. Hoshizaki is testifying regarding subjects outside of his field or knowledge; however, a review of Dr. Hoshizaki's testimony establishes that his opinion and testimony is squarely within his knowledge base as he performs impact reconstructions from NHL game video and forms conclusions by applying that data to information from scientific literature routinely referenced in his work.

The NHL has failed to provide a basis to exclude Dr. Hoshizaki's testimony, particularly considering the stage of the litigation—class certification. The Court should deny the NHL's Motion.

BACKGROUND

Dr. Thomas Blaine Hoshizaki is an expert who determined the exposure of NHL players to blows of such force that they damage brain tissue.

Dr. Hoshizaki is a Professor of Human Kinetics who specializes in research involving injury from direct impacts to the head. (Declaration of Thomas Blaine Hoshizaki, PhD [ECF Doc. No. 645] (hereinafter "Hoshizaki Decl.") ¶¶ 1-8, Ex. 1.) He has held a doctorate in exercise physiology for forty years, founded and currently directs the Neurotrauma Impact Science Laboratory at the University of Ottawa, worked as a biomechanical consultant in the sporting goods industry for major sports manufacturers (*e.g.* Nike, Bauer), and worked as a biomechanist, researcher, and professor for 40 years. (*Id.*) Moreover, Dr. Hoshizaki has published over 55 scientific articles journals and more than 165 presentations at scientific conferences involving head injuries in sport. (*Id.*) Dr. Shawn Marshall, professor at the University of Ottawa's Brain and Mind Research Institute, called Dr. Hoshizaki "*the* expert" in the field of brain-trauma research.[1] "No one else in the world is doing exactly this type and extent of research."[2] Dr. Hoshizaki exceeds the initial requirement reviewed by the Court—determining whether the expert has sufficient qualifications to testify. *See Humphrey v. Diamant Boart, Inc.*, 556 F. Supp. 2d 167, 174 (E.D.N.Y. 2008).

[1] https://www.theglobeandmail.com/report-on-business/industry-news/marketing/science-safety-and-sales-the-hockey-helmet-marketing-problem/article32311736/ (emphasis added).

[2] http://www.macleans.ca/society/health/the-aftershocks/.

In the current case, Dr. Hoshizaki analyzed video footage of the NHL from four different seasons, each from a different decade—1986-87, 1995-96, 2003-04, and 2013-14. (Hoshizaki Decl. ¶¶ 50, 52.) Dr. Hoshizaki's team used an established methodology to review the video and classify all impacts appearing on the videos by velocity (low, medium or high) and event (*e.g.* head to ice, head to head, puck to head, etc…). The team then selected an exemplar video for each event, at each velocity, and for each decade, that would be used to perform an impact reconstruction. (*Id.* ¶¶ 52-55.) Dr. Hoshizaki's team then slowed down those videos and measured the velocities of each impact. (*Id.* ¶ 56.) Accurate measurements were made possible because of the standardized, known reference markings and dimensions found on all NHL ice hockey rinks (*e.g.* goal lines, center lines, face-off circles, face-off dots, defensive zone lines). (*Id.* ¶ 19.) These events were then reconstructed using equipment designed to replicate accurately the impacts observed in the video and to obtain six dynamic response values for each impact. (*Id.*; (Rebuttal Declaration of Thomas Blaine Hoshizaki, Ph.D (hereinafter "Hoshizaki Rebuttal Decl.") ¶ 6.) The data from the reconstructions was put into a finite element model of the human brain, which model Dr. Hoshizaki had worked with on numerous occasions and for which he has a robust, comparative data set. (Hoshizaki Decl. ¶ 56; Hoshizaki Rebuttal Decl. ¶¶ 11-13.) The finite element model produced a prediction of maximum principal strain ("MPS") on the brain for each type of impact. (Hoshizaki Decl. ¶ 56.) Dr. Hoshizaki applied the MPS data to the number and type of head impacts for each of the videoed seasons and compared it to the amount of strain at which the scientific literature demonstrates functional impairments and undulations typical of

axonal injury. (*Id.* ¶¶ 43, 59, 65.) Based on that methodology, Dr. Hoshizaki formed an opinion regarding the amount of games an average NHL player would have had to play to receive a head impact sufficient to cause injury to brain tissue. (*Id.*)

As a world leader in research to decrease the risk of head injuries in sport, Dr. Hoshizaki, in combination with others such as Dr. Cantu, has demonstrated that all retired players are at an increased risk for developing NDDC due to the strains on brain tissue they experienced as NHL players. The threat this testimony poses to the litigation position NHL has taken with regard to the significance of repeated subconcussive hits, has resulted in the absurd, multi-pronged effort of five NHL experts to challenge Dr. Hoshizaki's conclusions. The NHL's legion of experts,[3] however, utterly fails to demonstrate that his careful, conservative methodology and opinions lack reliable foundation.[4] (*See generally* Def. Nat. Hockey League's Mem. Law Supp. Mot. Exclude Opinions and Test. of T.B. Hoshizaki [ECF Doc. No. 783] (hereinafter "NHL Hosh. Mem.").) The NHL's attempt to exclude Dr. Hoshizaki's testimony is an attempt to

[3] This includes professional experts, such as Dr. Funk who testifies every month or every other month and a vast majority of the time in support of the defense. (*See* Funk Dep. 26:12-25 – 27:1-9, 28:3-10.)

[4] Plaintiffs respond here to what the NHL argues in its memorandum. Additional contentions by experts submitted via declaration but not included in those argument are inappropriate, as well as tacitly superfluous. *See Crossley v. Georgia-Pacific Corp.*, 355 F.3d 1112, 1114 (8th Cir. 2004) (refusing to consider facts buried in lengthy exhibits where brief failed to detail which specific facts were relevant, because "[j]udges are not like pigs, hunting for truffles"). In the event that the Court intends to consider assertions in the various affidavits of the NHL's attacking experts regardless of whether they are used by the NHL in its motion and memorandum, Plaintiffs would like the opportunity to counter these superfluous points.

replace the adversary system's "[v]igorous cross-examination, presentation of contrary evidence, and careful instruction on the burden of proof" that are the "traditional and appropriate means" of attacking evidence that is admissible, even where an opposing party believes the evidence to be "shaky." *See Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579, 596 (1993). Dr. Hoshizaki presents conservative conclusions based on facts, data, and a process that employed reliable and verified principles and methods. *See* Fed. R. Evid. 702. To the extent the NHL has evidence that contradicts Dr. Hoshizaki's testimony and conclusions, that is a contest for trial. The NHL's claims that Dr. Hoshizaki's testimony should be excluded are without merit, and their motion should be denied.

STANDARD OF REVIEW

The admission of expert evidence is governed by Fed. R. Evid. 702 as further refined by the United States Supreme Court in *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579 (1993). Application of the *Daubert* factors should result in "the liberal admission of expert testimony." *Johnson v. Mead Johnson & Co., LLC*, 754 F.3d 557, 562 (8th Cir. 2014). Therefore, "*[o]nly* if the expert's opinion is so fundamentally unsupported that it *can offer no assistance to the jury* must such testimony be excluded." *Id.* Indeed, whether an expert's opinion meets the *Daubert* standard is not based on whether that opinion "has the best foundation," but rather, whether "the particular opinion is based on valid reasoning and reliable terminology." *Oddi v. Ford Motor Co.*, 234 F.3d 136, 145 (3d Cir. 2000). Adherence to this liberal spirit—and in fact

observance of a lighter burden—is particularly important when motions attacking expert testimony are brought at the *class certification stage*, as here.

"A court's inquiry on a motion for class certification is 'tentative,' preliminary,' and 'limited'" because it must decide "only if 'questions of law or fact common to class members predominate over any questions affecting only individual members [and if] a class action is superior to other available methods for fairly and efficiently adjudicating the controversy." *Cox v. Zurn Pex, Inc. (In re Zurn Pex Plumbing Prods. Liab. Litig.)*, 644 F.3d 604, 613 (8th Cir. 2011) (internal citations omitted). Indeed, "[e]xpert disputes 'concerning the factual setting of the case' should be resolved at the class certification stage only to the extent 'necessary to determine the nature of the evidence that would be sufficient, if the plaintiff's general allegations were true, to make out a prima facie case for the class.'" *Id.* at 611 (quoting *Blades v. Monsanto Co.*, 400 F.3d 562, 567 (8th Cir. 2005)).

Given the limited nature of a court's examination of expert testimony at the class certification stage, "an exhaustive and conclusive *Daubert* inquiry before the completion of merits discovery cannot be reconciled with the inherently preliminary nature of pretrial evidentiary and class certification rulings." *Id.* Indeed, "[t]he main purpose of *Daubert* exclusion is to protect juries from being swayed by dubious scientific testimony. That interest is not implicated at the class certification stage where the judge is the decision maker" simply because "'there is less need for the gatekeeper to keep the gate when the gatekeeper is keeping the gate only for himself'" or herself. *Id.* (quoting *United States v. Brown*, 415 F.3d 1257, 1269 (11th Cir. 2005)). As the Eighth Circuit has noted "[w]e

have never required a district court to decide conclusively at the class certification stage what evidence will ultimately be admissible at trial." *Id.* at 611.

In fact, attempts to exclude experts at the class certification stage have not typically been successful within the Eighth Circuit in the wake of *Zurn. E.g., In re Gobal Tel*Link Corp. ICS Litig.*, No. 5:14-CV-5275, 2016 U.S. Dist. LEXIS 163900, *17 (W.D. Ark. Nov. 29, 2016) ("The Court believes that judicial economy is poorly served, and the likelihood of prejudicial error is increased, by striking or excluding expert evidence prior to making any ruling on class certification."); *In re Target Corp. Customer Data Sec. Breach Litig.*, No. MDL 14-2522, 2015 U.S. Dist Lexis 119063, *3 (D. Minn. Sept. 8, 2015) (holding that the defendant's attempt to exclude expert based on argument that it was not possible to measure a common impact from data breaches on financial institution class members rejected); *Ascaro LLC v. NL Industries, Inc.*, 106 F. Supp.3d 1015, 1022-23 (E.D. Mo. 2015) (denying the motion to exclude contamination expert's report at class stage due to absence of sampling locations or methodology denied in view of *Zurn* standard; noting that questions concerning factual bases and underpinnings of such a report go to weight); *Ebert v. General Mills, Inc.*, No. 13–3341, 2015 U.S. Dist. LEXIS, *17 (D. Minn. Feb. 27, 2015) (fact that expert in environmental exposure case could not testify as to uniform exposure or homogenous threat not a basis for exclusion at class certification stage).

Even when applying *Daubert* to determine admissibility at trial, courts are careful not to make determinations about weight and credibility, which are questions for the jury. Indeed, "it is not the role of the district court to make ultimate conclusions as to the

persuasiveness of the proffered evidence," nor is the *Daubert* analysis "intended to supplant the adversary system or the role of the jury." *Quiet Technology DC-8, Inc. v. Hurel-Dubois UK Ltd.*, 326 F.3d 1333, 1341 (11th Cir. 2003) (citing *Maiz v. Virani*, 253 F.3d 541, 666 (11th Cir. 2001)).

These principles were explained and applied in *Quiet Technology*, a case that the Eighth Circuit relied upon in *Zurn*, 644 F.3d at 614-15. The *Quiet Technology* Court determined that the bases on which the opposing party sought to exclude the expert's opinions "are of a character that impugn the accuracy of his results, not the general scientific validity of his methods." 325 F.3d at 1345. The *Quiet Technology* Court ultimately determined that "the identification of such flaws in generally reliable scientific evidence is precisely the role of cross-examination." *Id.* The court also emphasized that "in most cases, objections to the inadequacies of a study are more appropriately considered an objection going to the weight of the evidence rather than its admissibility." *Id.* at 1345 (quoting *Hemmings v. Tidyman's Inc.*, 285 F.3d 1174, 1188 (9th Cir. 2002)). Where, as here, the expert's "methods and results were discernible and rooted in real science—*i.e.*, were 'intellectually rigorous'—they [are] empirically testable," they are subject to effective cross examination and thus admissible. 326 F.3d at 1346.

The NHL's motion fails to recognize both the inherent flexibility of the *Daubert* standard and the sacrosanct role of the jury in weighing expert testimony and evaluating credibility. Ultimately, the NHL's motion must be denied because its arguments are based either on an overly stringent—and therefore improper—application of the *Daubert* factors (tempered even further by *Zurn*'s relaxed class-stage standards), or on misplaced

criticisms of the sort rejected in *Quiet Technology* that go to the weight and credibility of expert opinions.

The NHL's criticism of Dr. Hoshizaki demonstrates its faulty understanding of the legal standard to be applied in a *Daubert* motion. The NHL's principal criticisms of his calculations and analysis are based on allegations of improper use of computer software, errors in calculations, failures to include certain variables, supposed inadequacies of underlying studies, and disagreements about sampling sizes. All these criticisms are unfounded. Yet, even if they were correct, these are factors that the *Quiet Technology* Court noted were ripe for testing by the adversarial process, and therefore, did not serve as a basis for exclusion under *Daubert*. The remainder of the NHL's criticisms focus on Dr. Hoshizaki's qualifications and the fact that he did not calculate an error rate as part of his testing. Proper application of the *Daubert* factors does not support exclusion in such circumstances and the Court should deny the NHL's motion.

ANALYSIS

I. BECAUSE DR. HOSHIZAKI ACCOUNTED FOR THE VARIABLES THE NHL RAISES AS AREAS OF CONCERN, HIS VIDEO ANALYSIS IS SOUND.

Dr. Hoshizaki observed 4630 head impacts that were captured on video in 120 NHL games over four decades. (Hoshizaki Decl. ¶ 13.) He calculated the impact velocity and impact angles using the same computer software that he has used in his lab to conduct the same calculations thousands of times with regard to other head impacts observed on video in sport. The software used to take these measurements and make these calculations has been verified by comparison to a robust data set, with more than

600 real data points with known injury outcomes against which to compare the results. (Hoshizaki Rebuttal Decl. ¶¶ 8.d.i, 18.)

The NHL attempts a flawed "death by a thousand cuts" approach, beginning with the contention that there were problems with the manner in which Dr. Hoshizaki reviewed and measured the video footage from past NHL seasons. (NHL Hosh. Mem. 9-20.) However, where the concern raised about an expert's opinion and testimony is about the inputs into a methodology leading to inaccurate results, it is a concern that can be addressed in the course of cross-examination as opposed to excluding testimony all-together. *Quiet Technology*, 326 F.3d at 1345 (noting objections to the inadequacies in a study are considered an objection to the weight rather than its admissibility)). Furthermore, failure to include variables in an analysis typically concerns its probative value, not its admissibility. *Id.* at 1346 (quoting *Bazemore v. Friday*, 478 U.S. 385, 400 (1986)). The general methodology of reviewing prior video footage and assembling reconstructions of impacts from the video is not contested, even by the NHL's experts; rather, the claimed concerns relate to the manner in which the various portions of that methodology were carried out.

Dr. Hoshizaki conducted the video analysis carefully to ensure reconstructions were accurate, including adopting internal procedures established to detect and rectify anomalous errors. (Hoshizaki Rebuttal Decl. ¶¶ 19.b, 20.) The NHL's critiques concern potential variables in conducting the analysis, rather than the general methodology itself, such as: claimed insufficient ice markings to conduct video measurement; head movements being too distant in a frame; and failure to dissect the game footage through a

composite of measures (*e.g.* de-interlacing, stabilizing, down-sampling, accounting for lens distortion and panning/zooming, etc…).[5] (NHL Hosh. Mem. at 9-20.) Analyzing video and performing reconstructions to determine MPS is sound, and, in fact, even engaged in by the NHL's own expert. However, the NHL contends that there were faulty parameters, wrong numbers, and variables in Dr. Hoshizaki's analysis; however, these are the types of criticisms that go to weight, as opposed to admissibility.

Moreover, the criticisms are themselves erroneous. First, many of the NHL's concerns regarding the video relate to the capacity for measurement of a hockey player that is moving in different directions over time (NHL Hos. Mem. at 9-10) are no concern at all; the measurement captures only .20 seconds of movement pre-impact and .015 seconds of the impact (Hoshizaki Rebuttal Decl. ¶ 21 ("[V]elocity is measured in a very short time frame, specifically within .20 seconds prior to impact until .15 seconds after; the brief nature of the period of measurement eliminates any effect of "bobbing" or "weaving" of the head. Humans actually move, relatively speaking, very slowly. To change the direction of a 10 pound head in .2 seconds requires an impact"); *see also* Funk Dep. 40:8-9 (noting that the impact is a very brief span of time) 132:5-12 (accepting that the impact is .011 to .025 seconds)).

[5] The shrill nature of the NHL's convoluted criticisms of Dr. Hoshizaki's video review is exemplified by its expert Dr. James Funk's convenient conclusion that it is simply impossible to do a scientifically reliable analysis of hits and their impact based on the video footage available for those seasons. (Deposition of James R. Funk (hereinafter "Funk Dep.") 77:3-25 – 78:1, 136:3-25 – 137:1-4, 190:10-25 – 191:1-4, at Declaration of David Cialkowski (hereinafter "Cialkowski Decl."), Ex. 1.)

Second, Dr. Hoshizaki took adequate steps to attend to potential concerns such as head displacement. (Hoshizaki Rebuttal Decl. ¶ 19.a.)

Third, Dr. Hoshizaki used criteria when choosing the videos used for in-lab re-construction that ensured the most accurate results—clarity of the impact, proximity of the calibration grid to the impact, size of the calibration grid, orientation of the calibration grid, impact perpendicular to the camera plane, quality of the referenced dimensions, and whether the event was centered in the field of view. (*Id.* ¶ 19.d.)

Fourth, the NHL's overly fastidious critique about time differences relating to "down-sampling" and "de-interlacing" are overblown when one considers the relatively slow velocity of human movement; such velocities (between 1.53 m/s to 7.63 m/s) are easily captured using videos down-sampled in the manner set forth by Dr. Hoshizaki. (*Id.*)

Fifth, Dr. Hoshizaki's analysis already countered concerns about lens distortion by choosing events primarily taking place in the center, or close to the center, of the lens. (*Id.* ¶¶ 19.e, 19.f.)

Finally, Dr. Hoshizaki's lab reviewed each frame individually and analyzed it with appropriate reference and calibration procedure, thereby eliminating the NHL's concerns about panning and zooming. (*Id.* ¶ 19.h.) So on top of the video-related issues belonging in the category of input versus methodology, they are not really issues in the first place.

Dr. Hoshizaki's methodology was validated by his comparison with the NHL's own statistics, in addition to a robust, populated data set, further undercutting the NHL's

criticisms.[6] For example, the number of head impacts per game that Dr. Hoshizaki measured is very close to those that were identified by the NHL itself over a study of 1,898 NHL games with differences attributable to the different games analyzed and methods of characterization. (*Id.* ¶ 5.) The validation of Dr. Hoshizaki's analysis is evidenced not only in the number of hits, by the NHL's own measure, but also by the magnitude of the impacts when compared to scientific literature, all of which establish that the analysis was, if anything, conservative and under-inclusive. (*Id.* ¶ 5.d) In fact, had Dr. Hoshizaki not performed this analysis using the most conservative methodologies to gather data, but rather relied entirely on comparative literature and studies, his figures for frequency, velocity, and strain from head impacts would have been higher. (*Id.* ¶ 5.f)

The NHL's concerns with the video analysis therefore do not provide a basis for the exclusion of Dr. Hoshizaki's testimony.

II. NHL'S ARGUMENTS THAT DR. HOSHIZAKI DID NOT ACCOUNT FOR POST-IMPACT VELOCITY ARE INCORRECT, AND IN ANY CASE GO TO THE WEIGHT OF THE EVIDENCE.

One of the primary bases on which the NHL asks that this Court exclude Dr. Hoshizaki's testimony is the unfounded claim that Dr. Hoshizaki's measurements failed to account for post-impact velocity or the elasticity of the collision in accounting for the movement of both collision partners. (NHL Hosh. Mem. at 2, 13-14, 22.)

[6] Not only did Dr. Hoshizaki validate the methodology, but if anything, Dr. Hoshizaki's analysis is conservative in that analysis of game video necessarily does not include all impacts that occur, such as with analyses that use Head Impact Telemetry systems ("HITs"). (*See* Hoshizaki Rebuttal Decl. ¶¶ 5.b.)

First, to the extent that the NHL's claim is that Dr. Hoshizaki should have measured the post-impact velocity of the struck player in the video—and then ensured that the post-impact velocity of the head form in the reconstruction matched—that is merely a manner of confirming the reconstruction. (Hoshizaki Rebuttal Decl. ¶ 6.e.) However, such validation is not necessary because Dr. Hoshizaki employed a head form that is itself validated for appropriate biodynamic response of the head. (*Id.*; *see also* Funk Dep. 194:7-13.) Furthermore, the reconstruction equipment, including the instrumented Hybrid III head form, the compliant unbiased neck, and the sliding table, all allow a replication of change in velocity from the striking player to the struck player, including glancing versus direct blows. (Hoshizaki Rebuttal Decl. ¶ 6.a.) Second, Dr. Hoshizaki accounted for elasticity, including compliance of the various components of a collision, whether using the actual surfaces themselves (such as ice or wood) or foam forms that accurately mimic the body part. (*Id.* ¶ 6.c.)

Second, even if Dr. Hoshizaki had not accounted for post-impact velocity, the NHL's apparent contention that Dr. Hoshizaki did not include the variable of post-impact velocity into his analysis is insufficient to support excluding the entirety of his testimony. *Quiet Technology*, 326 F.3d at 1344, 1346 (noting further that expert testimony is not excluded based on claims that there was a misapplication of generally valid principals underlying the larger methodology).

In short, the NHL's claims concerning post-impact velocity merely constitute a confirming step since post-impact velocity is accounted for by the equipment used in the

reconstructions. Even were that untrue, a claimed failure to include one variable in the calculation does not warrant exclusion of Dr. Hoshizaki's testimony.

III. DR. HOSHIZAKI PROPERLY DOCUMENTED AND TESTIFIED ABOUT THE IMPACT RECONSTRUCTION PROCESSES.

The NHL repeatedly claims that Dr. Hoshizaki should have made video recordings of the laboratory reconstructions and that because he did not, his opinions and testimony should be excluded. (NHL Hosh. Mem. at 21-24.) The caselaw cited by the NHL appropriately describes the requirements of an expert in relation to preservation of data and documentation of steps. *See Zenith Electronics Corp. v. WH-TV Broadcasting Corp.*, 395 F.3d 416, 418 (7th Cir. 2005) (excluding testimony on the basis that the expert made *no* effort to make calculations or use data to inform his projections, but simply referred to his own expertise or intuition); *Am. & Foreign Ins. Co. v. Gen. Elec. Co.*, 45 F.3d 135, 139 (6th Cir. 1995) (excluding expert who had novel theory and failed to preserve raw data, in addition to not calibrating his instruments); *Coffey v. Dowley Mfg., Inc.*, 187 F.Supp.2d 958, 978 (M.D. Tenn. 2002) (excluding an expert who did not physically test the product); *Rembrandt Vision Techs., L.P. v. Johnson & Johnson Vision Care, Inc.*, 282 F.R.D. 655, 666-67 (M.D. Fla. 2012) (excluding an expert who had "serious deviations" from applicable scientific standards and because he failed to document and disclose the procedures he used). But, none of these decisions even suggests, much less demonstrates, that because Dr. Hoshizaki did not video-record the accident reconstructions, the entirety of his opinion and testimony should be excluded.

Dr. Hoshizaki documented the steps that he took and detailed them in his initial declaration, as well as expanding upon them in both his deposition testimony and his rebuttal declaration, including: the game footage that was used, the manner in which the game footage was analyzed, the manner in which impacts were chosen for reconstruction, the reconstruction, the input of the reconstruction data into the finite element model, and the resulting strain amounts. The fact that Dr. Hoshizaki provided sufficient evidence of his procedures and data is borne out by the fact that the NHL's experts have been able to critique the numerous and well-described steps and inputs. Dr. Hoshizaki has also produced his data, which the NHL has found in the tables of his original declaration about which he was questioned during his deposition, and which made its way into the substance of the NHL's declarations. Dr. Hoshizaki and Plaintiffs withheld nothing.[7] The facts and caselaw do not support exclusion of Dr. Hoshizaki's opinion and testimony on the basis that he did not video record the performance of his analysis.

IV. THE NHL FAILS TO DEMONSTRATE THAT DR. HOSHIZAKI'S TESTIMONY SHOULD BE EXCLUDED ON THE BASIS OF QUESTIONS CONCERNING STUDENT ASSISTANTS.

The NHL asks the Court to exclude Dr. Hoshizaki's testimony for failure to supervise his students on two primary grounds—that Dr. Hoshizaki could not remember

[7] The NHL also suggests that "[Dr.] Hoshizaki and plaintiffs' counsel" failed to produce, as of its April 27, 2017 motion, various parcels of information and vaguely responded that production remains pending. (NHL Hosh. Mem. at 20.) However, this statement is breathtakingly *untrue*; items that the NHL describes as never produced were provided to the NHL via Plaintiffs' counsel's April 4, 2017 correspondence to Jessica Miller, attorney for the NHL, including Kinovea results, equipment/mass/stiffness information for reconstructions, and an explanation as to player's weights. (Cialkowski Decl. ¶ 3, Ex. 2.)

the names of his student assistants during his deposition (though he said he could provide that information at a later point, and in fact did)[8] and could not explain the figures on a particular piece of paper about which opposing counsel was quizzing him. (NHL Hosh. Mem. at 19-21.) First, the unpublished decision from the District of Utah on which the NHL relies does not address the use of assistants as the NHL suggests. *See Petersen v. Daimler Chrysler Corp.*, No. 1:06-CV-00108-TC, 2011 WL 2491026 (D. Utah June 22, 2011) (regarding experts' ability to rely on other experts' or scientists' conclusions, but not involving student assistants). Second, the testimony the NHL cites is a back-and-forth regarding one of many documents from Dr. Hoshizaki's analysis and what the numbers represent. (*See* Hoshizaki Dep. T. 467:4-472:12, available at Ex. 1 of Connolly Hosh. Decl.) The exchange does not evidence a lack of familiarity with the methods and reasoning used; if anything, it represents a lack of familiarity with that particular document. (*See id.*) Dr. Hoshizaki's familiarity with the method and reasoning used is more than adequately set forth in his initial declaration and rebuttal declaration. Dr. Hoshizaki also explained in his deposition that there is instruction on methodology of performing tasks in the laboratory that is conveyed in the form of apprenticeship. (*Id.* 46:12-19.) The inability to recall lab assistants' names at a deposition regarding testing that had occurred the previous year, and a lack of clarity about numbers on a single sheet of paper, have no bearing on the overall reliability of Dr. Hoshizaki's testimony. The names were provided to the NHL later and Defendant never bothered to follow up.

[8] *See* Declaration of Daniel Connolly Supp. Mot. Exclude Hoshizaki [ECF Doc. No. 784] (hereinafter "Connolly Hosh. Decl."), Ex. 13 at 4.

V. DR. HOSHIZAKI HAD MORE THAN A SOUND BASIS FOR HIS USE OF MAXIMUM PRINCIPAL STRAIN TO MEASURE BRAIN IMPACT.

In developing his assessment of the effects of head impacts to NHL players, Dr. Hoshizaki used maximum principal strain ("MPS") as the measurement of predicted strain to brain tissue in his analysis of the relative effects of head impacts in hockey. (Hoshizaki Decl. ¶ 22.) Dr. Hoshizaki used MPS because it is the most commonly used and accepted metric for such a measurement. (*Id.*) The NHL takes issue with Dr. Hoshizaki's use of MPS as the measurement of trauma and claims that its very use should exclude Dr. Hoshizaki's testimony, claiming that the more appropriate measurement would have been axonal strain. (NHL Hosh. Mem. at 30-33.) These claimed deficiencies by the NHL are yet another example of its unfounded attacks on Dr. Hoshizaki's well-reasoned and sound analysis.

Dr. Hoshizaki made the decision to use MPS as the measurement in his analysis because MPS has a known and demonstrated ability to predict trauma to the brain, and is commonly used by experts in the field. (Hoshizaki Rebuttal Decl. ¶ 8.a.) There is no dispute about the point that the NHL trumpets as a revelation—that MPS is the measurement of strain on an element, as opposed to strain along an axon. (*See Id.* ¶ 8.b.) Dr. Hoshizaki's measurements were never intended to represent strain thresholds for axons in the brain; instead, the measurements are intended to measure predicted brain tissue strain. (*Id.* ¶.) The NHL's distinction has little significance as MPS strain can be the same as axonal strain and in the very least, the MPS values are associated with the

concept of axonal strain. (*Id.* ¶ 8.c.) Thus, the NHL points to no good, much less dispositive, reason to choose axonal strain over MPS to express strain.

In fact, there is a very good reason *not* to use axonal strain. In its rush to criticize, the NHL's experts and arguments wholly fail to grasp, as an expert's methodology should, that results are valid by comparison to a known data set. Dr. Hoshizaki's laboratory has more than 600 real data points with known injury outcomes against which the results expressed in MPS could be compared. (*Id.*) In stark contrast, the anisotropic (*i.e.* axonal) model *has no data set* to use for comparison so that it can be determined if the results of any measurements using the anisotropic model were valid. (*Id.* ¶ 8.d.i.) As a result, the anisotropic model is purely theoretical and not validated. (*Id.*) The best that an anisotropic model could do would be to model the effect of axonal tracks. There is no way to determine if the values (even if lower) represent actual axonal strain without a validating data set. (*Id.*) Even if the NHL was correct that axonal strain was theoretically a more "accurate" model, the results could not be verified and thus useless in the real world. (*Id.*) Likewise, the scientific literature provides data points for strain level thresholds resulting in concussions, which are measured in MPS. (*Id.* ¶ 8.d.ii.) For these reasons, MPS as the measure is a far more certain and accurate measure than the axonal strain. As a result, Dr. Hoshizaki's methodology and results are the most accurate because they have been validated with the most robust data available.

VI. DR. HOSHIZAKI'S USE OF A FINITE ELEMENT MODEL TO MEASURE THE IMPACT ON THE BRAIN IS MORE THAN REASONABLE.

In arriving at his conclusions about the frequency, magnitude, and duration of head trauma, and resulting overall strain to NHL players' heads, Dr. Hoshizaki employed a finite element model—a digital model of the brain designed to help understand the strain created by the observed impacts. The NHL attacks Dr. Hoshizaki for using a finite element model, and in particular for using the University of College Dublin finite element model (hereinafter the "UCD"). (NHL's Hosh. Mem. at 24-30.) However, the NHL's criticism of Dr. Hoshizaki's use of the UCD is hollow and fails to appreciate the reason that Dr. Hoshizaki employed the model.

First, the NHL points out that finite element models are experimental research tools that shouldn't be used to diagnose injury. (*Id.* at 24.) Dr. Hoshizaki acknowledges that finite element models are, true to their name, models, and as such all have certain limitations. (Hoshizaki Rebuttal Decl. ¶ 11.)[9] However, a finite element model such as

[9] The NHL makes an additional argument in an attempt to twist Dr. Hoshizaki's words so as to meet *Daubert* precedent concerning the rigor with which an expert must address their work to be admissible. (*See* NHL Hosh. Mem. at 25-27.) Dr. Hoshizaki presented his initial declaration, by which he stands, and when asked about the finite element model in deposition testimony admitted that there are limitations to a finite element model by definition. (Hoshizaki Dep. 71:19-72:4.) Dr. Hoshizaki went on to explain that the presence of limitations was not set forth in his initial declaration as it would be in a scientific paper (*Id.* 77:3-6); however, this statement concerned the format of the declaration, not the care with which he approached the necessary accuracy of his work (Hoshizaki Rebuttal Decl. ¶ 16). Furthermore, the caselaw cited by the NHL pertained to the exclusion of an expert who had a "statement he previously made in a peer-reviewed article that contradict[ed] his safety opinion proffered in [that] case." *Wilkerson v. Boston Scientific Corp.*, No. 2:13-cv-04505, 2015 WL 2087048, *15 (S.D. W.V. May 5, 2012). There is no such contradiction warranting exclusion here.

the UCD provides strain values that account for a wide range of impacts to aid in understanding the effects of impact to the head. (*Id*.)

Second, the NHL takes specific issue with Dr. Hoshizaki's use of the UCD as the finite element model claiming the UCD is not as up-to-date as other models and is basic and unsophisticated. (NHL's Hosh. Mem. at 27-28.) However, these claims by the NHL ignore the most important quality of the model—that it can be verified. One of the primary reasons that Dr. Hoshizaki chose the UCD rather than other finite element models is that Dr. Hoshizaki has a populated data set of more than 600 documented head impacts in sport, 120 of which are hockey-specific, with *known outcomes* using the UCD, thereby providing a manner to compare and verify the reconstructions and measurements in his analysis. (Hoshizaki Rebuttal Decl. ¶ 12.)[10] The NHL's analysis is wholly devoid of any discussion concerning the vital importance of a verified data set, which is an omission that begs the question of the qualifications of the NHL's *own* experts concerning the finite element model. (*Id*.)[11] Not only is there a sound basis for Dr. Hoshizaki to have used the UCD to analyze the data he culled from the impact

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[10] It warrants noting that Dr. Hoshizaki's lab runs both the Wayne State finite element model, as well as the Dublin model and have used both; so, Dr. Hoshizaki has familiarity with, and access to, various finite element models but has chosen the Dublin model. (Hoshizaki Dep. T. 58:12-20.)

[11] The NHL's expert—Dr. Funk admits that the finite element model has had some validation, but merely believes there is not full validation until it can be compared to a data set, which Dr. Funk claims does not exist but people are working on. (Funk Dep. 96:18-25 – 97:1-17.)

reconstructions, it is a basis that only serves to strengthen Dr. Hoshizaki's expertise and calls into question those who do not concern themselves with it.

Third, the NHL contends that the material properties employed in running the finite element model were improper, specifically that Dr. Hoshizaki used linear viscoelastic properties. (NHL Hosh. Mem. 28-29.) In determining the material properties for input into the UCD, he chose the GWV (Grey, White Ventricles) linear viscoelastic model. (Hoshizaki Rebuttal Decl. ¶ 13.) Dr. Hoshizaki chose GWV in order to validate his methodology by comparing it to the aforementioned data set of more than 600 sports-related head impacts; that data set used the GWV variant and would not be comparable unless he did the same. (*Id*.) The linear viscoelastic model also more accurately accounts for the effect of the magnitude and duration of the acceleration on the brain tissue. (*Id.* ¶ 14.) Another of the serial attempts by the NHL to undercut the reliability and foundation of Dr. Hoshizaki's testimony is thus readily explained as an intentional act by Dr. Hoshizaki to ensure that the methodology and results presented in this litigation were accurate.

Not only has Dr. Hoshizaki established sound reasons for employing the tools he did, but in the *Daubert* setting, "substantial criticism as to one theory or procedure will not be enough to find that the theory/procedure is not generally accepted." *United States v. Bonds*, 12 F.3d 540, 562 (6th Cir. 1993). The Court should deny the NHL's motion seeking to exclude the opinions and testimony of Dr. Hoshizaki.

VII. DR. HOSHIZAKI IS NOT PROHIBITED FROM RELYING ON PUBLISHED SCIENTIFIC LITERATURE REGARDING BRAIN CELL CHANGES OBSERVED AT CERTAIN STRAIN LEVELS.

The NHL attempts to undermine Dr. Hoshizaki's use of a 5%-8% threshold strain against which to compare the results of his accident reconstruction[12] and provide an opinion on three bases: 1) that MPS is not a reliable measurement; 2) that the studies on which Dr. Hoshizaki relies do not address brain damage in humans; and 3) that the studies Dr. Hoshizaki relies upon concern transitory changes, not permanent damage. (NHL Hoshizaki Mem. at 34-41.) As to the reliability of MPS as the unit of measure, *see infra* § E. Dr. Hoshizaki's reliance on studies derived from animals did not extrapolate those studies too far and was necessary as human testing is prohibited. Lastly, Dr. Hoshizaki acknowledges that the studies setting the 5-8% threshold include transitory changes as well as the possibility of some permanent damage, but the connection between those changes and damage to white matter provide a sound basis for using that threshold in developing Dr. Hoshizaki's data set and ultimate opinion.

A. Dr. Hoshizaki Appropriately Used Information Established by Scientific Literature to Provide a Threshold Against Which to Compare the Results of His Research.

Dr. Hoshizaki is a leading expert on observing real-world head trauma, reconstructing that trauma in his lab, and determining what level of strain to brain tissue occurred. Dr. Hoshizaki draws heavily on this expertise in providing his opinions on what

[12] "When combined, validated finite element models and tissue tolerance data offer a means to identify the hazardous mechanical environments that cause [diffuse axonal injury]." A.C. Bain & D.F. Meaney, *Tissue-level thresholds for axonal damage in an experimental model of central nervous system white matter injury*, 122 J. Biomech. Eng. 615, 615 (2000).

levels of MPS NHL players have experienced over the last several decades. Experts also properly rely on published literature where the research in that literature has been reviewed by the expert's "critical eye" developed in their professional career. *Buck v. Ford Motor Co.*, 810 F. Supp. 2d 815, 842 (N.D. Ohio 2011). This Court has recognized that examining literature in one's field and drawing conclusions from it is commonly accepted methodology and that expert opinions can be based on professional experience as well as professional studies. *Block v. Woo Young Med. Co.*, 937 F. Supp. 2d 1028, 1042 (D. Minn. 2013). The limits of an expert's experience in a field go to the weight of the opinion to be assessed via the deliberative process of trial. *Buck*, 810 F. Supp. 2d at 842 (citing *Daubert*, 509 U.S. at 596 ("[v]igorous cross-examination, presentation of contrary evidence, and careful instruction on the burden of proof are the traditional and appropriate means of attacking shaky but admissible evidence").

In the course of arriving at his opinion that an average NHL player likely receives a head impact over the course of two games sufficient to cause permanent injury to brain tissue (Hoshizaki Decl. ¶ 65; Hoshizaki Rebuttal Decl. ¶ 31), Dr. Hoshizaki referred to, and relied upon, criteria established by other scientists concerning the level of maximum principal strain that results in damage to brain tissue. (*See, e.g., id.* ¶ 43, n. 46, 47.) Dr. Hoshizaki is a leader in the field of head injuries in sport, demonstrated by more than 55 scientific articles in peer-reviewed journals, including multiple articles in the *Journal of Neurosurgery*, and over 165 presentations at scientific conferences on the topic, including the relationship between humans in sport and protective headwear. (Hoshizaki Decl. ¶ 5, Ex. 1.) Dr. Hoshizaki's work in the sports equipment field included involvement in the

design of protective headwear in order to reduce, and where possible eliminate, the risk of brain tissue damage from impacts. (Hoshizaki Rebuttal Decl. ¶ 28.) Understanding where the impact/strain thresholds were for brain tissue injury was an essential and regular part of that work by Dr. Hoshizaki, above and beyond the need to understand and have knowledge of it to make his academic contributions. (*Id.* ¶ 29.) In addition, Dr. Hoshizaki's approach of applying the results of his biomechanical reconstructions to results in scientific literature is not novel. The NHL's own expert—James Funk—has himself been part of projects making "an assessment of the risk of brain injury based on the biomechanical measurements [they] recorded" and the level of brain risk injury was based on values from the field or literature. (Funk Dep. 18:7-17.)

Dr. Hoshizaki appropriately relied on the results of other scientists to establish a threshold for neuronal cell damage (*see, e.g.*, Hoshizaki Decl. ¶ 17, n. 1; ¶ 43, n. 46)[13] against which he could gauge the results of his laboratory reconstructions of NHL head impacts to arrive at his opinion on the number of damaging head impacts a game an average NHL player would suffer (Hoshizaki Decl. ¶ 65).[14] One of the criteria on which

[13] Citing T. Yuen et al., *Sodium channelopathy induced by mild axonal trauma worsens outcome after a repeat injury*, 87 J. NEUROSCI. RES. 16, 3620-25 (2009) (determining that a threshold of mild traumatic axonal injury determined by pathologic changes were present at 5% strain and above); B.S. Elkin, B. Morrison 3d, Region-specific tolerance criteria for the living brain, 51 STAPP CAR CRASH J, 127-38 (2007) (stating that threshold for injury exists between 10 and 20% strains, but noting that the hippocampus was vulnerable to stretch injury at even 5% strain).

[14] Compare to the NHL's own expert who made statements in his Declaration that came from other experts of the NHL without any attribution to the same. (*Compare* Funk Decl. ¶ 39 (making assertions about the finite element model's ability to measure anisotropic material) *with* Funk Dep. 105:1-19 (admitting that the assertion made in Dr. Funk's

Dr. Hoshizaki relied was the *minimum* level of strain that resulted in changes to the white matter and cells of 5%. (*Id.* ¶ 43, n. 46.) This measurement was derived from work that the NHL's own experts admit there is no basis to believe is scientifically unreliable. (Funk Dep. 184:7-10.) Dr. Hoshizaki also looked at other criteria in scientific literature, including scientific authors reporting that maximum principal strain between 19-26% corresponded to a more than 50% risk of diagnosed concussion. (Hoshizaki Decl. ¶ 22, n. 7.) Dr. Hoshizaki then applied the maximum principal strain data that was produced through his accident reconstructions from review of NHL footage. (Hoshizaki Decl. ¶ 59, Tables 5, 6.) Dr. Hoshizaki's accident reconstructions were sorted into three levels—high, medium, and low velocity. (*Id.*) Dr. Hoshizaki observed that the reconstructed head impacts for the low velocity impacts had maximum principal strain amounts primarily between 10 and 13 percent MPS (except head impacts to the boards and head impacts to the ice which had 18 and 24 percent MPS respectively). (*Id.*; *see also* Hoshizaki Rebuttal Decl. ¶ 31 (correcting certain of those numbers).) As a result, Dr. Hoshizaki concluded that the reconstructed head impacts primarily measured in significant excess of the 5% minimum threshold associated with white matter injury. (*Id.*)

The results of Dr. Hoshizaki's laboratory reconstructions of actual NHL impacts over the course of four decades can just as readily be applied to other strain thresholds

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Declaration is actually the assertion of a different expert and not from his own knowledge); *see also* Funk Dep. 106:16-25 – 107:1-23 (clarifying what parts of the paragraph were his knowledge and which were actually the knowledge of others).)

that scientific literature demonstrates create brain tissue injury. (*See* Hoshizaki Rebuttal Decl. ¶ 27.) Applying an 8% strain threshold, shown to be the beginning of conduction block in spinal nerve roots,[15] the MPS results from the impact reconstructions would demonstrate that an NHL player would receive such an impact or greater by playing in an average of .99 games.[16] (Hoshizaki Rebuttal Decl. ¶ 27.a.) Applying a 10% strain threshold, shown to be the level at which there is evidence of torn axonal fibers concomitant with observed functional injury and macroscopic hemorrhaging often resulting in cell death,[17] an NHL player would receive such an impact or greater by playing in an average of 1.11 games. (*Id.* ¶ 27.b.) Applying a 14% strain threshold, determined by a study as the conservative threshold for morphological damage to white matter,[18] an NHL player would receive such an impact or greater by playing an average of 1.55 games. (*Id.* ¶ 27.c.) And even at a 21% strain threshold, which certain scientific literature has determined is the optimal threshold for morphological damage to white

[15] A. Singh, *et al.*, *A new model of traumatic axonal injury to determine the effects of strain and displacement rates*, 50 STAPP CAR CRASH JOURNAL, 601, 609 (2006) (cited in Hoshizaki Decl. at 19 n. 46).

[16] The number of games an NHL player would play in order to be subject to an impact at the given threshold (*e.g.* 8%, 10%, 14%, 21%) was calculated by: reviewing Table 5 of my Initial Declaration to determine which types of events were below the given threshold; then removing those sub-threshold events from Tables 2-4; then taking the total number of remaining events (supra-threshold) and dividing it by the total number of games (120) by the total number of players (38) and taking the reciprocal. (*See* Hoshizaki Rebuttal Decl. ¶ 27.)

[17] *Id.*

[18] Bain & Meaney, *supra* n. 14.

matter,[19] an NHL player receives such an impact having played in a mere 4.35 games. (*Id.* ¶ 27.d.) Application of the MPS results from Dr. Hoshizaki's laboratory impact reconstructions does not significantly alter the fact that NHL players played in very few games before receiving impacts that cause damage to brain tissue. (*Id.* ¶ 27.)

Based on the frequency and MPS level of impacts to the head sustained by NHL players in the 120 games of video footage analyzed, Dr. Hoshizaki concludes that an NHL player would experience an impact of greater than the 5-8% threshold playing in a single NHL game.[20] (Hoshizaki Rebuttal Decl. ¶ 27.) Dr. Hoshizaki, an expert in his field, based on the significant amount of data derived from the video analysis and subsequent laboratory reconstructions applied to the research on brain injury, and the conservative nature of his measurements that do not include off-camera and practice session impacts, arrived at his opinion that an average NHL player receives impacts

[19] *Id.*

[20] In Dr. Hoshizaki's original declaration, he concluded that an average NHL player likely received a head impact in each game sufficient to cause permanent injury to brain tissue. (Hoshizaki Decl. ¶ 65.) At the inception of his deposition, Dr. Hoshizaki clarified that he had discovered a miscalculation in his tables resulting from dividing certain figures by the number of players on one team in a game (19) versus both teams (38). (Hoshizaki Dep. T. 11:4-22 – 12:1-9.) Dr. Hoshizaki clarified that the effect of the change was that the lowest number of IPG (the 1986-87 season in Table 8 of his declaration) was not 1.19, but rather .6. (*Id.* 12:21-22 – 13:1-6; *see also* Hoshizaki Decl. at 33, Table 8; Hoshizaki Rebuttal Decl. ¶ 31.) Dr. Hoshizaki has calculated the data in Table 8 using the 38 players and determined the impacts per game accordingly. (Hoshizaki Rebuttal Decl. ¶¶ 27, 31.) As he testified, if that lowest, most conservative ".6" number from the 1986-87 season were used as the only referent, then a player would be expected to experience an impact at the 5-8% MPS level more than once every two games; however, when the number of impacts per game are averaged across all seasons, the average player experienced that amount of strain in a single game. (*Id.* ¶ 27, Ex. A.)

significant enough to result in permanent cell changes in the brain tissue by playing one NHL game. (*Id.*)

Dr. Hoshizaki appropriately applied the results of his video analysis, reconstruction, and finite element modeling in his laboratory to thresholds of cell damage as determined by others in the scientific field. There is no basis for excluding the testimony of Dr. Hoshizaki.

B. Dr. Hoshizaki Properly Relied on Animal Studies Discussing Cell Damage Thresholds.

The Eighth Circuit does not discount the value of animal studies *per se*. *Glastetter v. Novartis Pharmaceuticals Corp.*, 252 F.3d 986, 991 n. 5 (8th Cir. 2001). Even where courts are cautious in presuming animal study findings are applicable to humans, that applicability can be explored in cross-examination at trial. *In re Viagra Products Liability Litigation*, 572 F.Supp.2d 1071, 1089 (D. Minn. 2008). However, courts will exclude expert evidence that is based on animal studies when the studies are relied upon for more than that which they actually provide. *See, e.g., Glastetter*, 252 F.3d at 990 (cited in NHL Hosh. Mem. at 34) (excluding expert testimony claiming that active ingredient in pharmaceutical caused constriction that could have caused stroke on the basis that no study ever concluded that stroke was associated with the active ingredient nor were the studies designed to reveal whether the ingredient could cause strokes); *In re Baycol Products Litigation*, 532 F.Supp.2d 1029, 1065 (D. Minn. 2007) (cited in NHL Hosh. Mem. at 34) (excluding expert testimony because there were scientifically known

dose-response differentials for pharmaceutical testing that were not applied).[21] In contrast, Dr. Hoshizaki's reliance upon the scientific literature involving animal studies does not extrapolate those studies beyond that which they provide. Dr. Hoshizaki relied upon the studies for exactly what the studies set out to provide: the point of strain at which brain cell damage through lost function or otherwise begins.[22] (*See, e.g.*, Hoshizaki Decl. ¶¶ 23-24, nn. 9-12.) Furthermore, Dr. Hoshizaki acknowledges that the studies that set out these thresholds are based on animals; however, as is true with many scientific studies, the information available in literature concerning prospective head trauma research *cannot ethically be performed on humans*. (Hoshizaki Rebuttal Decl. ¶ 30; *see also* Hoshizaki Dep. T. 124:17-22.) However, case studies coupled with animal studies show associations for humans reinforced by causation among animals. (Hoshizaki Rebuttal Decl. ¶ 30.)[23] The studies relied upon by Dr. Hoshizaki were at the

[21] The NHL's quotation slyly removes the distinguishing phrase "because of the dose response differential between animals and humans." (*Compare* NHL Hoshizaki Mem. at 34 *with Baycol*, 532 F.Supp.2d at 1065.) This is a distinguishing characteristic that obviously does not exist here. The NHL points to no relevant differences between animals and humans with regard to the present subject matter.

[22] Statements like those quoted by the NHL from Dr. Olanow's supplemental declaration suggest that the scientific literature derived from animal studies is being used to extrapolate the impacts themselves, when a reading of Dr. Hoshizaki's declaration shows that they are not being relied upon to that extent. (*See* NHL Hosh. Mem. at 34 (quoting Olanow Supp. Decl. ¶ 71 describing the protection of human brains by bone and skin).)

[23] "Evidence suggests that the mechanical behavior of [central nervous system] tissue does not vary greatly from species to species, so that strain-based injury criteria may be very similar between species." A.C. Bain & D.F. Meaney, *Tissue-level thresholds for axonal damage in an experimental model of central nervous system white matter injury*, 122 J. Biomech. Eng. 6, 615, 615 (2000), article cited in Hoshizaki Declaration at 7 n. 1, 10 n. 11.

cellular level and were not related to the introduction of a foreign substance (a pharmaceutical) where dosage would be a concern and were not relied upon to show concussions themselves. Rather, they were simply relied upon to provide the cell reaction thresholds to strain in an area where human study is not possible or expected. As a result, the testimony and opinions of Dr. Hoshizaki, which use scientific literature merely to provide the threshold at which damage to brain cells occurs, are reliable and admissible. The matter of threshold levels can be explored in the course of cross-examination at trial, but is not a basis for completely excluding Dr. Hoshizaki's opinion and testimony.

C. Dr. Hoshizaki Does Not, and Has Not, Claimed that at 5%-8% MPS, a Player Will Experience "Permanent Brain Injury," but Rather that the Threshold is the Beginning of Injury Resulting to Brain Tissue.

The NHL attacks Dr. Hoshizaki's opinions and testimony claiming that the 5-8% mark is not the threshold for permanent brain injury and therefore Dr. Hoshizaki's opinion is unreliable. (NHL Hosh. Mem. at 34, 37.) The fact that the NHL can knock down its own straw-man is unremarkable.

First, Dr. Hoshizaki is merely relying on information from scientific literature to determine a level against which to apply the results of his reconstructions. (*See supra* § VII.A.)

Second, Dr. Hoshizaki is not contending, and has not contended, that at 5% MPS, there is "permanent injury" to an individual, as the NHL claims. (Hoshizaki Rebuttal Decl. ¶ 26.) Dr. Hoshizaki's opinion is "that NHL hockey players experience a significant level of brain trauma contributing to an increased *risk* of brain damage."

(Hoshizaki Decl. ¶ 65 (emphasis added).) The risk results from the frequency of head impacts that "create significant levels of brain tissue strain and its associated injuries to brain tissue." (*Id.*) The impact level at which the risk for brain damage starts is logically the impact level at which strain begins to effect brain cells and their function. (Hoshizaki Rebuttal Decl. ¶ 25.) Even according the NHL's own expert, axonal injury is a continuum starting with electrophysiological impairment moving to *morphological damage*—which is permanent changes in cells—and through to failure, which continuum the scientific literature starts at 5% strain. (*See* Funk Decl. Fig. 9 at 27; Funk Dep. 158:21-25 – 159:1-19.) Originally, that same expert for the NHL testified in his declaration that the lowest axonal strain level at which scientific literature evidenced morphological damage occurred was 14%, but the expert had to issue a correction because in fact, the very article on which Dr. Hoshizaki relied for his strain rate referenced morphological changes at the 5% strain level. (Funk Dep. 166:11-25 – 167:1-2, Ex. 9.)

Third, Dr. Hoshizaki acknowledges that evidence of damage or changes in white matter at the 5%-8% level is potentially reversible and not always permanent. (Hoshizaki Rebuttal Decl. ¶ 26.) That said, scientific literature also indicates there is a strong association between the 5%-8% level of MPS and damage to the white matter. (*Id.*) Even the NHL's own experts acknowledge that the studies on which Dr. Hoshizaki relies demonstrate that as low as the 5% MPS level, there are functional alterations in the brain cell's activities. (*See* NHL Hosh Mem. at 37 (citing Funk Decl. ¶ 42).) In addition, Dr. Cantu opined that calcium accumulation at those levels "may also activate proteases that

eventually lead to cell damage or death and, in axons, excess Ca2+ can lead to dysfunction and breakdown of neurofilaments and microtubules." (Expert Report of Robert C. Cantu, M.A., M.D., FACS, FAANS, FICS, FACM [ECF Doc. 646] ¶ 42.)

The criticisms by the NHL therefore have nothing to do with the soundness of Dr. Hoshizaki's scientific analysis. At most, this is a dispute about the threshold strain levels at which white matter damage occurs – a dispute that can be resolved at trial—and which does not concern the reliability of Dr. Hoshizaki's testimony.

D. The NHL Does Not Dispute That Tissue Damage Occurs from Subconcussive Blows, and the Dispute over Cell Damage Thresholds Has Relatively Negligible Results on the Overall Conclusion.

There does not appear to be a general dispute by the NHL that subconcussive impacts can cause tissue damage. (*See generally* NHL Hosh. Mem.) The NHL's issue appears to be with the 5%-8% MPS threshold employed by Dr. Hoshizaki against which he applied the results of his impact reconstructions of impacts in NHL games. (*See id.*) However, other thresholds for cell impairment established through studies in the field would not greatly alter the ultimate results of Dr. Hoshizaki's study based on the impact magnitude and resulting MPS strains. (*See* Hoshizaki Rebuttal Decl. ¶ 27.) For example, using an 8% strain threshold, the point at which conduction block begins per the study by Anita Singh and others, an average NHL player would sustain a blow of a magnitude for that damage to occur once every game. (Hoshizaki Rebuttal Decl. ¶ 27.a.) At a 10% strain threshold, the point at which the same authors determined there was evidence of torn axonal fibers and macroscopic hemorrhaging, an average NHL player would sustain a head blow sufficient to cause that damage once every 1.11 games. (*Id.* ¶ 27.b.) A 14%

strain threshold, determined by authors Bain & Meaney as the conservative threshold for morphological damage, an average NHL player would receive a damaging head blow of that magnitude once every 1.55 games. (*Id.* ¶ 27.c.) Even at a 21% strain threshold, the "optimal threshold" for determining morphological damage to white matter according to those same authors,[24] it would still demonstrate that an average NHL player sustains a blow with a magnitude sufficient to cause brain cell impairment once every 4.26 games. (*Id.* ¶ 27.d.) Therefore, the primary focus of the NHL's motion, even if completely credited, does not significantly alter the ultimate conclusion and underscores the largely immaterial nature of their objections to Dr. Hoshizaki's testimony and conclusions.

VIII. THE NHL AND ITS EXPERTS CONTORT DR. HOSHIZAKI'S RESULTS TO CREATE UNWARRANTED AND SENSATIONALIZED ABSURDITIES.

The NHL contends that the MPS values employed by Dr. Hoshizaki to determine threshold cell damage would indicate that routine activities such as "plopping" into a chair, jumping rope, or "slapping" one's forehead would result in "permanent brain injuries." (NHL Hosh. Mem. at 3, 38 (citing Declaration of Dr. Matthew Panzer [ECF Doc. 732-10] (hereinafter "Panzer Decl.") ¶¶ 64-67).) This claim, which is obviously made with the hopes that it will cast a shadow of absurdity onto Dr. Hoshizaki's opinion and testimony, is fostered by credibility-destroying deficiencies and false characterizations. First and foremost, Dr. Hoshizaki has never stated that "permanent brain injury" occurs at any time there is 5%-8% MPS. (Hoshizaki Rebuttal Decl. ¶ 9.a.)

[24] This is also the threshold that the NHL's expert James Funk claimed would be a more reasonable approach than Dr. Hoshizaki's threshold. (Funk Dep. 162:13-25 – 163:1-2).

Dr. Hoshizaki's testimony is that the scientific literature establishes that at 5%, impairment of brain cells begins. (Hoshizaki Decl. ¶ 43.)

Second, the numbers that were used by Dr. Panzer, the NHL's expert, to arrive at his conclusions are obviously flawed, as evidenced by the dynamic response values being incredibly low compared with the resulting claimed MPS values. (Hoshizaki Rebuttal Decl. ¶ 9.b; *see also* Funk Dep. 142:16-25 – 143:1, 150:19-25 (admitting that MPS with those variables being absurd).) In Dr. Hoshizaki's decades-long experience of studying the very subject of resulting MPS from various impacts, he has neither heard of nor seen an impact at 4 g and 200 rad/s2 result in 45% MPS (Hoshizaki Rebuttal Decl. ¶ 9.b), which is precisely what the NHL and Dr. Panzer claim (Panzer Decl. ¶ 67, Figure 10). Dr. Hoshizaki has never, in completing hundreds of impact reconstructions using the UCD model, observed MPS values assigned to those activities with those very low acceleration values. (Hoshizaki Rebuttal Decl. ¶ 9.b.) Further, Dr. Hoshizaki is not aware of any data, published or unpublished, that is consistent with the MPS values that Dr. Panzer and the NHL assigned to these activities. (*Id.*) Furthermore, Dr. Panzer fails to cite *any* literature to provide any validation for the numbers that Dr. Panzer employed. (*Id.*) Moreover, Dr. Panzer's results cannot be verified due to the vague description of how he arrived at the extraordinarily high MPS values. (*Id.*).

Third, the numbers presented by the NHL and Dr. Panzer demonstrate that Dr. Hoshizaki's results are, if anything, very conservative if not low. (Hoshizaki Rebuttal Decl. ¶ 9.b.) If Dr. Panzer's analysis for the respective "every day activities" is correct as to the percentage of MPS created by the low variable inputs (*e.g.* acceleration), then Dr.

Hoshizaki's conclusions as to the MPS created by much higher variable inputs is actually conservative. As an example, if Dr. Panzer's analysis was correct that a head shake results in 45% MPS, then Dr. Hoshizaki's determination of 41-43% MPS for a high velocity punch to the head, high velocity head to board impact, and medium velocity head to ice impact was extremely conservative if not low; this is particularly true considering those events had 13-21 times the peak linear acceleration of the head shake, and 22-36 times the peak rotational acceleration. (*Id.* (illustrating the same for all of Dr. Panzer's exaggerated MPS results for everyday activities).) In contrast to Dr. Panzer's claims, which would result in everyone in the world being at an increased risk of NDDC, the dynamic response values and MPS in Dr. Hoshizaki's declaration reflect head impacts consistent with the reported MPS values. (*Id.*) Dr. Panzer's sensationalized claim lacks common sense and only demonstrates the reasonableness of Dr. Hoshizaki's figures and methodology.

IX. THE NHL MISCHARACTERIZES THE BREADTH OF DR. HOSHIZAKI'S TESTIMONY IN AN ATTEMPT TO MAKE HIM APPEAR UNQUALIFIED.

The NHL contends that Dr. Hoshizaki's opinions are beyond his expertise and therefore, his opinions and testimony are inadmissible. (NHL Hosh. Mem. 41-45.)[25] The

[25] Inexplicably, the NHL holds out their own experts in manners wholly outside their field or experience while still making this contention. (*Compare* NHL Hosh. Mem. at 13 (citing to the Neale letter concerning how critical it is to measure both objects in a collision to properly analyze the impact) *with* Neale letter at 1 (describing his education in architecture, photography, videography, and computer visualization, but failing to show any biomechanics education or experience).)

NHL's contention is a naked attempt to extend Dr. Hoshizaki's testimony beyond the scope in which it was given.

Dr. Hoshizaki's Initial Declaration is extraordinarily clear concerning the capacity in which he is providing his testimony; he is a professor of biomechanics and an expert on the topic of traumatic head injuries. (Hoshizaki Decl. ¶¶ 1, 7.) Dr. Hoshizaki is also the founder and current director of the Neurotrauma Impact Science Laboratory at the University of Ottawa. (*Id.* ¶ 3.) Perhaps most importantly, Dr. Hoshizaki has worked as a biomechanist, researcher, and professor of physical education for almost four decades. (*Id.*) Dr. Hoshizaki has also worked as a consultant to the private sector in the world of sporting equipment, specifically in helping to develop protective headwear to reduce and where possible eliminate brain tissue damage as the result of impacts. (Hoshizaki Rebuttal Decl. ¶¶ 28-29.) To perform his work as a consultant, as well as his work in the academic sphere, Dr. Hoshizaki had to understand the thresholds of impact that cause damage to brain tissue. (*Id.*)

Dr. Hoshizaki's own declaration sets the scope of his opinion and the fact that his opinions will be derived via scientific literature as well as his own testing and video analysis:

> I was asked to provide an opinion concerning brain trauma characteristics associated with head impacts experienced in the National Hockey League ("NHL"). Specifically, I was asked to opine on i) the biomechanical forces involved in a concussive or subconcussive blow, ii) the effects of concussive or subconcussive blows on the brain, iii) the types of blows to the head incurred by NHL players in an average season during four different decades, and iv) the level of maximum principal strain ("MPS") NHL players were exposed to during an average season.

(*Id.* ¶ 10.) Dr. Hoshizaki has never claimed to be an expert in the litany of areas set out by the NHL as though they are a revelation. (*See* NHL Hosh. Mem. at 44.) Dr. Hoshizaki's testimony clearly and systematically moves through the process by which he arrived at his opinions, including his reliance on and citation to scientific literature. (*See generally* Hosh. Decl.) The entirety of Dr. Hoshizaki's initial declaration is best summed up as: "The published literature describing head trauma in ice hockey, in combination with the number of impacts, level of impacts, and associated tissue trauma contribute to my opinion that NHL hockey players experience a significant level of brain trauma contributing to an increased risk of brain damage." (*Id.* ¶ 65.) There is nothing about that methodology or that opinion that requires Dr. Hoshizaki to step outside of his expertise based on his reliance upon scientific literature.[26] This reliance on scientific literature for parts of an interdisciplinary study is exactly what the NHL's own expert James Funk described doing in submitting his declaration in this case. (Funk Dep. 154:5-25 – 156:6.) As described in Dr. Hoshizaki's deposition testimony:

> We study … what we call trauma brain profiling, and so we understand trauma based … on the other research that has identified elements like frequency and duration between impacts, and how long, and the magnitude of the impact, and how long the impact the person has been receiving stress, if you like, or encountering stress in the sport. And so we use these indicators to better understand the sport itself, and it's those – those data

[26] The NHL claims that all biomechanical engineers are very constrained as to their testimony. (NHL Hosh. Mem. at 41-42.) However, a review of Dr. Hoshizaki's background, education, and scientific writings demonstrate that he is well within his field to testify concerning the application of the outcome of his research, head trauma reconstruction methodologies, and finite element modeling analyses. Further, Dr. Hoshizaki was careful to provide ample citation when the statement was based on the work of others and these citations run contrary to the NHL's claims. (*See, e.g.*, Hoshizaki Decl. ¶ 32, n 30, ¶ 33, n 31; ¶ 34, n 32; ¶ 35, n 35; ¶ 41, n 41.)

> sets that help us understand the related risk to neurodegenerative disease or neurological disease.

(Hoshizaki Dep. 60:19-22 – 61:1-10.) Dr. Hoshizaki is incredibly experienced in the field of head trauma and sports. Dr. Hoshizaki was well within the bounds of his knowledge in providing the opinions and testimony set forth in his Initial Declaration and his Rebuttal Declaration.

X. THE NHL'S CLAIM THAT DR. HOSHIZAKI'S SAMPLE WAS NOT REPRESENTATIVE IS NOT ONLY SPECIOUS BUT CONSTITUTES THE TYPE OF CRITICISM RIPE FOR CROSS-EXAMINATION IN TRIAL AS OPPOSED TO EXCLUSION.

Dr. Hoshizaki and his laboratory reviewed video footage from 120 NHL games, taken over four different seasons and a variety of teams, which displayed a sum of 4630 head hits. (Hoshizaki Decl. ¶ 13.) Despite this, the NHL asserts that Dr. Hoshizaki's analysis was not representative. (NHL Hosh. Mem. at 45.) The NHL postulates that it is "conceivable" that aspects of the cameras might have caught hits with a certain clarity so as to catch just the largest and most noteworthy, of the large sample of 120 games. (*Id.*) Or, the NHL offers, the findings might not have been representative because the data did not break down every difference "in players' bodies and potential exposures to injuries, including variation in playing time, career length, individual and team style of play, equipment worn and individual anatomy." (*Id.* at 46.) Outside of this sheer speculation, the NHL has not presented any *evidence* to demonstrate that in fact the 120 games reviewed were not representative or that the impact measurements by Dr. Hoshizaki that were validated by an existing data set were error because of the various listed difference. Furthermore, the relative proximity in Dr. Hoshizaki's conclusions concerning the

number of hits per game with the NHL's own analysis with a survey of more than 1,800 games (*see* Hoshizaki Rebuttal Decl. ¶ 5) belies this claim by the NHL. The similarities between Dr. Hoshizaki's measurements and the NHL's own measurements of impact frequency were consistent even though the games were not reviewed, lending even further credence to the soundness and reliability of Dr. Hoshizaki's study. (*See Id.*) Furthermore, the NHL's own expert admitted that Dr. Hoshizaki attempted to gather a representative sample in his video analysis (Funk Dep. 173:23-25 – 174:1-8), and that he did not selectively exclude data (*Id.* 175:4-12). There is no basis to exclude Dr. Hoshizaki's testimony, including in relation to the representativeness of his analysis.

XI. DR. HOSHIZAKI'S DECLARATION PROVIDES AN ERROR RATE, BUT IN ANY CASE ERROR RATE IS NOT EVEN A *DAUBERT* REQUIREMENT.

Daubert sets forth several factors that are non-exclusive that a court *can* apply, one of which is the known or potential rate of error. *Lauzon v. Senco Products, Inc.*, 270 F.3d 681, 686-87 (8th Cir. 2001). It is not even necessary for the Court to consider or require known or potential rate of error. *See Blandin Paper Co. v. J&J Industrial Sales, Inc.*, No. Civ. 02-4858 ADM/RLE, 2004 WL 1946388, *4 (D. Minn. Sept. 2, 2004) (allowing expert evidence despite failure to test, publish articles or measure a potential error rate because it would not change the result and noting the defendant could attack the weight of the evidence in cross-examination). Certain *Daubert* factors, including specifically potential rate of error, are not considered if they are not relevant. *See Pestel v. Vermeer Mfg. Co.*, 64 F.3d 382, 384 (8th Cir. 1995) (affirming the district court's decision to not consider rate of error). That said, standards of deviation have been

accepted by courts reviewing the rate of error *Daubert* factor. *See In re Jacoby Airplane Crash Litig.*, No. 99-6073 (HAA), 2007 U.S. Dist. LEXIS 71012 (D.N.J. Aug. 27, 2007); *cf. Indianapolis Minority Contractors Ass'n v. Wiley*, CASE NO. IP 94-1175-C-T/G, 1998 U.S. Dist. LEXIS 23349, *46 (S.D. Ind. May 13, 1998); *Hernandez v. Crown Equip. Corp.*, 92 F. Supp. 3d 1325, 1346 (M.D. Ga. 2015); *see also* Funk Dep. 82:16-21 (admitting standard of deviation is a part of error rate). While the NHL claims that no such rate of error was set forth in Dr. Hoshizaki's initial declaration (NHL Hosh Mem. 46-47), Dr. Hoshizaki included the rate of error by setting forth the standard deviation in the MPS measurements, as shown in Table 7 of his declaration. (*See* Hoshizaki Decl. at 31-32, Table 7.) Should the Court desire to review the known or potential rate of error in serving its gate-keeping function, Dr. Hoshizaki has thus provided it and certainly it could be explored in the course of cross-examination.

CONCLUSION

The NHL's multi-pronged attack on the testimony of Dr. Hoshizaki relates to aspects of his analysis that courts have repeatedly held are subject to cross-examination at trial as opposed to exclusion at this stage in the case. Moreover, the NHL's experts would have the world believe that a scientifically valid evaluation of player impacts from prior seasons is not even possible; in other words, the effects of the NHL's conduct in prior seasons could never be evaluated. The Court should not countenance such a position. For all the reasons set forth herein, the Court should deny the NHL's Motion to Exclude the Testimony of Dr. Hoshizaki.

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